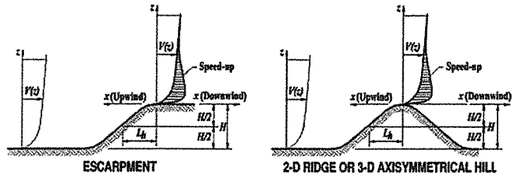
Diagrams



ESCARPMENT

2-D RIDGE OR 3-D AXISYMMETRICAL HILL

Topographic Multipliers [a,b,c,d]

H/L_h	K_1 Multiplier			x/L_h	K_2 Multiplier		z/L_h	K_3 Multiplier		
	2D Ridge	2D Escarpment	3D Axisymmetrical Hill		2D Escarpment	All Other Cases		2D Ridge	2D Escarpment	3D Axisymmetrical Hill
0.20	0.29	0.17	0.21	0.00	1.00	1.00	0.00	1.00	1.00	1.00
0.25	0.36	0.21	0.26	0.50	0.88	0.67	0.10	0.74	0.78	0.67
0.30	0.43	0.26	0.32	1.00	0.75	0.33	0.20	0.55	0.61	0.45
0.35	0.51	0.30	0.37	1.50	0.63	0.00	0.30	0.41	0.47	0.30
0.40	0.58	0.34	0.42	2.00	0.50	0.00	0.40	0.30	0.37	0.20
0.45	0.65	0.38	0.47	2.50	0.38	0.00	0.50	0.22	0.29	0.14
0.50	0.72	0.43	0.53	3.00	0.25	0.00	0.60	0.17	0.22	0.09
				3.50	0.13	0.00	0.70	0.12	0.17	0.06
				4.00	0.00	0.00	0.80	0.09	0.14	0.04
							0.90	0.07	0.11	0.03
							1.00	0.05	0.08	0.02
							0.50	0.01	0.02	0.00
							2.00	0.00	0.00	0.00

[a]For values of H/L_h, x/L_h, and z/L_h other than those shown, linear interpolation is permitted.

[b]For $H/L_h > 0.5$, assume that $H/L_h = 0.5$ for evaluating K_1 and substitute $2H$ for L_h for evaluating K_2 and K_3.

[c]Multipliers are based on the assumption that wind approaches the hill or escarpment along th direction of maximum slope.e

[d]Multipliers shall be used for any exposure.

Notation

H = Height of hill or escarpment relative to the upwind terrain, ft (m);
K_1 = Factor to account for shape of topographic feature and maximum speed-up effect;
K_2 = Factor to account for reduction in speed-up with distance upwind or downwind of crest;
K_3 = Factor to account for reduction in speed-up with height above local terrain;
L_h = Distance upwind of crest to where the difference in ground elevation is half the height of hill or escarpment, ft (m);
x = Distance (upwind or downwind) from the crest to the site of the building or other structure, ft (m);
z = Height above ground surface at the site of the building or other structure, ft (m);
μ = Horizontal attenuation factor;
γ = Height attenuation factor.

Equations

$K_{zt} = (1+K_1K_2K_3)^2$

K_1 = Determined from table above

$K_2 = (1-|x|/\mu L_h)$

$$K_3 = e^{-\gamma z/L_h}$$

Parameters for Speed-Up over Hills and Escarpments

Hill Shape	$K_1/(H/L_h)$ Exposure B	C	D	γ	μ Upwind of Crest	Downwind of Crest
2D ridges (or valleys with negative H in $K_1/(H/L_h)$)	1.30	1.45	1.55	3	1.5	1.5
2D escarpments	0.75	0.85	0.95	2.5	1.5	4
3D axisymmetrical hill	0.95	1.05	1.15	4	1.5	1.5

Figure 26.8-1. Topographic factor, K_{zt}.

$$q_z = 0.00256K_zK_{zt}K_eV^2(\text{lb/ft}^2);\ V, \text{mi/h} \qquad (26.10\text{-}1)$$

$$q_z = 0.613K_zK_{zt}K_eV^2(\text{N/m}^2);\ V, \text{m/s} \qquad (26.10\text{-}1.\text{SI})$$

where

K_z = Velocity pressure exposure coefficient, see Section 26.10.1;
K_{zt} = Topographic factor, see Section 26.8.2;
K_e = Ground elevation factor, see Section 26.9;
V = Basic wind speed, see Section 26.5; and
q_z = Velocity pressure at height z.

The velocity pressure at mean roof height is computed as $q_h = q_z$ evaluated from Equation (26.10-1) using K_z at mean roof height h.

The basic wind speed, V, used in determination of design wind loads on rooftop structures, rooftop equipment, and other building appurtenances shall consider the Risk Category equal to the greater of the following:

1. Risk category for the building on which the equipment or appurtenance is located, or
2. Risk category for any building or other structure to which the equipment or appurtenance provides a necessary service.

26.11 GUST EFFECTS

26.11.1 Gust-Effect Factor The gust-effect factor for a rigid building or other structure is permitted to be taken as 0.85.

26.11.2 Frequency Determination To determine whether a building or other structure is rigid or flexible as defined in Section 26.2, the fundamental natural frequency, n_1, shall be established using the structural properties and deformational characteristics of the resisting elements in a properly substantiated analysis. Low-rise buildings, as defined in Section 26.2, are permitted to be considered rigid.

26.11.2.1 Limitations for Approximate Natural Frequency As an alternative to performing an analysis to determine n_1, the approximate building natural frequency, n_a, shall be permitted to be calculated in accordance with Section 26.11.3 for structural steel, concrete, or masonry buildings meeting the following requirements:

1. The building height is less than or equal to 300 ft (91 m).
2. The building height is less than four times its effective length, L_{eff}.

The effective length, L_{eff}, in the direction under consideration shall be determined from the following equation:

$$L_{\text{eff}} = \frac{\sum_{i=1}^{n} h_i L_i}{\sum_{i=1}^{n} h_i} \qquad (26.11\text{-}1)$$

The summations are over the height of the building, where h_i is the height above grade of level i, and L_i is the building length at level i parallel to the wind direction.

26.11.3 Approximate Natural Frequency The approximate lower bound natural frequency (n_a), in Hz, of concrete or structural steel buildings meeting the conditions of Section 26.11.2.1 is permitted to be determined from one of the following equations.

For structural steel moment-resisting frame buildings,

$$n_a = 22.2/h^{0.8} \qquad (26.11\text{-}2)$$

$$n_a = 8.58/h^{0.8} \qquad (26.11\text{-}2.\text{SI})$$

For concrete moment-resisting frame buildings,

$$n_a = 43.5/h^{0.9} \qquad (26.11\text{-}3)$$

$$n_a = 14.93/h^{0.9} \qquad (26.11\text{-}3.\text{SI})$$

Table 26.10-1. Velocity Pressure Exposure Coefficients, K_h and K_z.

Height above Ground Level, z or h		Exposure		
ft	m	B	C	D
0–15	0–4.6	0.57 (0.70)*	0.85	1.03
20	6.1	0.62 (0.70)*	0.90	1.08
25	7.6	0.66 (0.70)*	0.94	1.12
30	9.1	0.70	0.98	1.16
40	12.2	0.74	1.04	1.22
50	15.2	0.79	1.09	1.27
60	18.3	0.83	1.13	1.31
70	21.3	0.86	1.17	1.34
80	24.4	0.90	1.21	1.38
90	27.4	0.92	1.24	1.40
100	30.5	0.95	1.26	1.43
120	36.6	1.00	1.31	1.48
140	42.7	1.04	1.34	1.52
160	48.8	1.08	1.39	1.55
180	54.9	1.11	1.41	1.58
200	61.0	1.14	1.44	1.61
250	76.2	1.21	1.51	1.68
300	91.4	1.27	1.57	1.73
350	106.7	1.33	1.62	1.78
400	121.9	1.38	1.66	1.82
450	137.2	1.42	1.70	1.86
500	152.4	1.46	1.74	1.89

*Use 0.70 in Chapter 28, Exposure B, when $z < 30$ ft (9.1 m).

Notes:

1. Velocity pressure exposure coefficient K_z may be determined from the following formula:

For $z < 15$ ft	$K_z = 2.41\,(15/z_g)^{2/\alpha}$
For $z < 4.6$ m	$K_z = 2.41\,(4.6/z_g)^{2/\alpha}$
For 15 ft (4.6 m) $\le z \le z_g$	$K_z = 2.41\,(z/z_g)^{2/\alpha}$
For $z_g < z \le 3{,}280$ ft (1,000 m)	$K_z = 2.41$

2. α and z_g are tabulated in Table 26.11-1.
3. Linear interpolation for intermediate values of height z is acceptable.
4. Exposure categories are defined in Section 26.7.